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# *The*
# MONTHLY REVIEW

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## *American Electroplaters Society*

A SOCIETY FOR THE ADVANCEMENT

OF THE

SCIENCE OF ELECTROPLATING

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# MONTHLY REVIEW

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## *American Electroplaters Society*

Publication and Editorial Office

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VOL. XVI MARCH, 1929 No. 3


## EDITORIAL

Now that we have all decided to go to the annual meeting at Detroit, June 8, 9, 10, 11, 1929, and have pledged ourselves to assist the research committee in interesting our employers and outside firms to contribute the upkeep of our fellowship at the Bureau of Standards at Washington, D. C., that is progressing rapidly under the direction of Dr. Wm. L. Blum for the benefit of the plating industry at large. It might be opportune to also agree to aid the educational committee of the convention by giving some heed to their requests for papers and titles of same that the programs may contain the information that will firmly imprint this event on all and encourage a large attendance to our annual event.

President Horace Smith and the executive board, at this time ask branch officers and members who have this work in charge to hurry it along and please send to convention educational committee the information asked that papers may be tabulated and program finished.

## RESEARCH MEETING

The Research Committee of the American Electro Platers' Society will hold a conference on Saturday, April 6th, at the Elks Club, Newark, N. J. The committee made this change from Washington, D. C., to Newark, N. J., to make it more convenient for the people from different sections of the country.

The purpose of this conference is to receive reports on the work done by the Bureau of Standards and the associates under the direction of the American Electro Platers' Society and to receive a report on the funds by the treasurer, and any suggestions and plans for the future work at the bureau.

A tentative program has been outlined as follows:

**Morning Session 9 A. M.**

Presiding, Oliver P. Sizelove

1—*Spotting Out:*

W. P. Barrows—(Research Associate, American Electroplaters' Society).

2—*Chromium Plating:*

(a) W. Blum—(Bureau of Standards). "Outline of Researches at Bureau of Chromium."

(b) H. R. Moore—(Bureau of Standards). "Conductivity of Chromic Acid Solutions."

(c) H. L. Farber—(Research Associate, American Electroplaters' Society). "Throwing Power in Chromium Plating."

(d) General discussion of chromium plating problem.

3—*Analysis of Cyanide Plating Solutions:*

M. R. Thompson—(Bureau of Standards).

**Afternoon Session**

2:00 P. M.—5:00 P. M.

R. J. O'Connor, Chairman Research Committee, Presiding.

4—*Measurement of pH Nickel Plating Solutions:*

(a) W. Blum—"Outline of the Investigation."

(b) Statement of Results by:

N. Bekkedahl (Bureau of Standards)
K. Pitschner (American Chain Co.)
C. J. Rosecranz (Leeds & Northrup)
F. R. McCrumb (LaMotte Chemical Products Co.)
A. K. Graham (University of Pennsylvania)
J. T. Burt-Gerrans (University of Toronto)

(c) Summary of pH.

5—*General Discussion of Nickel Plating Problems.*

6—*Addition Agents in Copper Electrotyping Solutions:*

R. O. Hull (Research Associate, International Association of Electrotypers).

7—*Iron Deposition:*

C. T. Thomas (Bureau of Engraving and Printing)

8—*Future Plans.*

All persons interested in the above subjects or work are invited to be present in person or by representatives.

PHILIP SIEVERING, Sec'y-Treas.

Persons wishing to make reservation of rooms will please write Mr. H. H. Smith, 208 North Third, at Newark, N. J., stating whether they will be accompanied by lady or not.

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## REMARKS ON CHROMIUM PLATING

**At Annual Banquet Chicago Branch A. E. S., Jan. 26, 1929**

**By Dr. O. P. Watts, U. of W. and Honorary Member A. E. S.**

After four years of commercial chromium plating in the United States, with a couple of years more in Germany thrown in for good measure, it would seem that the action of the chromium solution should be as thoroughly understood as that of any other plating solution. That this is far from being so all will admit. Some of the peculiarities of the chromic acid solution, either in composition or behavior, are:

1. The chromic acid solution has a metal concentration enormously greater than any other plating solution ever used. A nickel solution having 32 oz. of single sulphate per gallon contains 6.7 oz. of nickel, while the usual chromic acid solution of 32 oz. chromic acid contains 16.6 oz. of metal per gallon. If the metal concentration is considered in terms of chemical equivalents, that is if the amounts of metal are divided by the weights deposited at 100 per cent efficiency by equal currents, the chromium solution has 8½ times the available metal that is in the nickel bath. But the extremely low efficiency of chromium deposition lessens still further the rate of removal of metal from the film of solution at the cathode; if this be allowed for the effective metal concentration of the chromium solution exceeds that of the above nickel solution sixty-two fold.

2. The current density used in chromium plating exceeds many times that employed in any other plating solution. It is well, therefore, that its effective metal concentration so greatly exceeds that of other plating solutions.

3. Insoluble anodes are used in the chromium solution, which is the case in only one other plating bath, that for the deposition of platinum—and this is not by choice as with chromium, but by necessity, because a platinum anode is insoluble in its plating bath. Because no metal is supplied from the anode, it is again well that the chromium solution has such an extremely high metal content initially. This gives it a good start in life.

4. Chromic acid is a very strong oxidizing agent, yet hydrogen is abundantly evolved during plating. Three years ago the effect of nitrates in several plating solutions was tested in the writer's laboratory both by adding sodium nitrate to the regular plating bath and by using metallic nitrates for deposition. With sulphate solutions of iron and of nickel only 40 grams per liter (5.3 oz. per gal.) of sodium nitrate, a much less active oxidizing agent than chromic acid, almost completely prevented the deposition of metal and entirely suppressed evolution of hydrogen. One would naturally expect that such a great quantity of chromic acid would prevent the deposition of both chromium and hydrogen—but it does not seem to interfere in the least with either.

5. The chromium bath is unique among plating solutions in that its metal is initially nearly all in the higher of the two valences in which it exists in this solution, and it is generally agreed that chromium is deposited only from the lower or trivalent state. This means that metal deposition takes place in two stages; first, reduction from the valence of six to three, and second, an equally big step so far as using up current is concerned, deposition of metal from the trivalent state.

Deposition of iron from a solution of ferrous sulphate takes place with practically 100 per cent efficiency. But if one attempts to plate iron from a solution of ferric sulphate, in which the valence of iron is three instead of two, before any iron is deposited all or nearly all the metal in the film of solution in actual contact with the cathode, from which deposition takes place, must first be reduced to the ferrous state,

i.e. from a valence of three to two. So to deposit the same weight of iron from a ferric as from a ferrous solution requires at least 50 per cent more current. If in the ferric solution (ferric sulphate for example) an insoluble anode such as lead be used, some of the ferrous iron formed by reduction at the cathode will circulate to the anode, where it will be changed again to the ferric state. The first step toward deposition of metal, reduction to a lower valence at the cathode, is being partially undone at the anode. If the solution is stirred vigorously so that the ferrous iron formed at the cathode is all brought in contact with the anode, current may be passed indefinitely without any iron ever being deposited. Reduction at the cathode will be completely offset by oxidation at the anode.

The chromium solution has nearly all its metal in the highest valence, an insoluble anode is used, and the solution is a self-stirrer, since the hydrogen and oxygen liberated at the electrodes furnish stirring where this is most effective. The wonder is, not that the efficiency of the chromium solution is low, but that *any* metal is deposited. If man tried to design a plating solution of poor efficiency he could hardly go farther in that direction than the chromic acid solution.

5. Several experimenters have reported that chromium cannot be deposited from chemically pure chromic acid, but that a small quantity of chromium sulphate or some other trivalent salt must be present or be formed by the addition of some substance other than chromic acid.

6. It is generally said that deposition of chromium occurs solely from such trivalent salt as may be present, and that the chromic acid merely serves as a reservoir to supply metal for reduction to the trivalent state. If this is true one would expect that the more metal present in the trivalent state the higher would be he efficiency, as in a mixture of ferric and ferrous salts.

An objection urged against having much of the chromium reduced to the trivalent state is that the resistance becomes so great that too high a voltage is required to send the desired current through the solution. The fatal objection, however, to having much chromium in the trivalent state is that the efficiency of metal deposition is greatly lowered, just the opposite of what experience with other solutions would lead one to expect. A chromium solution which gave an excellent deposit was divided in half, and

to one lot enough chromium sulphate was added to make the concentration of this five times that in the original solution. The two solutions were electrolyzed in series with iron cathodes of equal size. The efficiency of the original solution was 13.8, but that to which chromium sulphate had been added was only 0.3 per cent. The behavior of the chromium solution is peculiar, to state it mildly.

7. Hydrogen can be caused to deposit at the cathode from every solution ever used for the deposition of metals by raising the current density to higher and still higher values; but at low and moderate current densities many solutions deposit only metal. In these there may be said to be a preference for deposition of metal instead of hydrogen. In a few solutions the prefernce is for deposition of hydrogen instead of metal, and in order to deposit metal efficiently such solutions must be neutral or only faintly acidified. In the chromic acid solution the preference for deposition of hydrogen instead of metal is greater than in any other plating solution—so great that at low and moderate current densities only hydrogen is deposited.

On passing a small current through a chromium solution no action is visible at the cathode. All the current is used in reducing chromium from the hexavalent to the trivalent state. On increasing the current considerably hydrogen is presently evolved. This is because hexavalent chromium does not reach the cathode fast enough to employ all of the larger current in reduction, and so enough hydrogen is deposited to make the total chemical changes at the cathode equivalent to that calculated from Faraday's law. On raising the current still further chromium is deposited along with hydrogen. Three actions are now going on simultaneously at the cathode: reduction of chromium from a valence of six to three, deposition of hydrogen, and reduction of chromium from a valence of three to zero, i.e. deposition of chromium. The preference among these three possible actions at the cathode is in the above order, but the distribution of current between them is affected by the current density, concentration of tri- and hexavalent chromium, the temperature, and perhaps other factors. In one experiment in which the hydrogen was collected it was found that 24 per cent of the current deposited chromium, and 59.6 per cent deposited hydrogen, leaving 16.4 per cent unaccounted for. The missing current was undoubtedly spent in reducing from the hexavalent to the trivalent state some chromium, which was swept

away from the cathode by the violent stirring produced by hydrogen before it could be further reduced to metal. By the use of lead anodes this trivalent chromium is changed again to the hexavalent state. Iron anodes are not so effective in oxidizing trivalent chromium as are lead anodes, so that such trivalent chromium as is swept away from the cathode accumulates in solutions in which iron anodes are used.

A few weeks ago an attempt was made to learn something about what has most puzzled the writer in chromium plating: 1st, that neither pure chromic acid nor pure chromium sulphate will serve as a plating solution, but that a mixture of them must be used; 2nd, that the mixture must contain its chromium almost entirely in the state of highest valence, diametrically opposite to theory and experience with other plating solutions.

Since hydrogen is deposited in preference to chromium from all these solutions it was thought that the different results might be due to a greater ease of depositing hydrogen from some solutions than from others. If there is no trivalent chromium present reduction of hexavalent chromium is a necessary process and preliminary to deposition of metal. Deposition of hydrogen is a waste of current, but it is only after the preference for deposition of hydrogen has been satisfied that the residue of current can deposit metal. In the hope of finding why one solution should waste practically all current in deposition of hydrogen, while another should use considerable of the total current usefully in depositing metal, observations were made of the "discharge potential" of hydrogen from different chromium solutions. The discharge potential of hydrogen is the polarization set up by hydrogen, and represents the opposition to deposition of more hydrogen.

The discharge of hydrogen is easier from solutions of hydrochloric and sulphuric acids, which contain many hydrogen ions, than from the sodium and potassium salts of these acids which contain few hydrogen ions. In normal solutions of the above acids and salts the discharge potential of hydrogen on the same metal is from 0.5 to 0.7 volts lower in the acid than in the salt solution. It is because of this lowering of the discharge potential of hydrogen by sulphuric acid that so little sulphuric acid may be present in nickel solutions. Much of this acid makes the deposition of hydrogen much easier than the deposition of nickel so that little or no metal is deposited.

The discharge potential of hydrogen was measured on polished copper cathodes in Sargent's solution, 250 g. chromic acid and 4 g. chromium sulphate per liter, in the same to which 200 g. chromium sulphate per liter had been added, in C. P. chromic acid, 250 g. per liter, and in pure chromium sulphate, 200 g. per liter. Besides the discharge potentials, which should be taken as approximations rather than exact values, minimum current densities are given for the deposition of hydrogen and chromium.

| | | Current density required for deposition of Hydrogen | | Chromium | |
|---|---|---|---|---|---|
| | D. P. of H. | Amp/dm² | Amp/ft² | Amp/dm² | Amp/ft² |
| Sargent bath ..... | +.110 | ..... | .... | .... | ..... |
| " plus Cr-sulp. | —.660 | 10 | 93 | 40+ | 362+ |
| Cr-sulphate ..... | —.073 | .09 | .8 | 10— | 93— |
| C. P. chromic acid.. | —.114 | .15 | 1.4 | 16+ | 150+ |

The discharge potential of hydrogen from the different solutions agrees well with their performance in plating. It is known that chemically pure chromic acid or sulphate alone deposits mainly hydrogen, and that any considerable increase of chromium sulphate in the Sargent solution produces a similar result. It is seen from the column marked D. P. of H. that the polarization, or opposition to deposition of hydrogen, is much greater in the Sargent than in any other solution, so that the Sargent solution ought to deposit less hydrogen and more metal than any of the other three solutions, as it does.

The current densities required for deposition of hydrogen tell an interesting story. In the Sargent-plus-sulphate solution the large current density required for deposition of hydrogen to begin means that the preference is for reduction of hexavalent chromium and that much current is used in this before any of the current deposits hydrogen.

The extremely low current density at which hydrogen appears in the chromium sulphate solution might be expected, since the only reduction possible here is from trivalent chromium to metal, and as has been pointed out before, this does not occur in chromium solutions until after deposition of much hydrogen.

The low current density at which hydrogen deposits from the pure chromic acid solution is surprising. In spite of a great concentration of hexavalent chromium almost no current is employed in its reduction at a copper cathode at low current density. Cathodes of other metals might show different results. Where the amperes for deposition of chromium are followed by a plus

sign, these are the current densities at which chromium first appears, and higher densities would be needed to cover the cathode completely.

During the past year a number of minor investigations connected with chromium plating have been carried out, and although most of these merely confirm the statements or results of others, a few may be new to some members here.

*The Effect of Stirring.*—In general stirring may be expected to have two effects in plating: 1st, to permit the use of higher currents without burning than can be employed in still solutions; 2nd, to change the efficiency, if this is not already 100 per cent.

Two types of stirring were tried: rotating a cylindrical cathode at 900 R.P.M., and the use of a propeller wheel at about the same speed. In each test the cells with the still and stirred solutions were connected in series electrically and the temperature was the same for each test, although it varied from 104° to 116° F. in different tests. With the rotating cathode the efficiency of metal deposition was increased about 3 per cent, while with mechanical stirring there was a slight lowering of efficiency. The deposits were equally bright and good. Stirring by the propeller was tried over a wide range of current density but no difference between plating in the still and stirred solutions could be detected. The only explanation offered for the unexpected results is that the violent evolution of hydrogen on the cathode was stirring the "still" solution so effectively that the added mechanical stirring had no measurable effect.

*The Difficulty in Plating Rough Spots.*—In the plating of brass, either from the use of too small a current or irregularity in shape of the object, it sometimes happens that one or more spots are not covered with chromium at once, in which case an excessive increase in current is necessary to cover the bare spots. Examination shows that the exposed brass has been corroded by the solution and roughened.

In order to deposit hydrogen from acids or form solutions of sodium or potassium salts by the electric current there is an opposing force, polarization, which must be overcome. This polarization lessens with increase in concentration of hydrogen ions in the electrolyte, and is therefore least in fairly strong solutions of sulphuric and hydrochloric acids, and varies for different metal cathodes, being highest on mercury and least on platinum. It also varies with the smoothness of the metal surface, being less on

rough than on smooth surfaces. It was thought that this phenomenon might explain the difficulty of plating rough spots, but attempts to measure the "discharge potential of hydrogen"—the potential of the cathode when hydrogen first appears—from a chromium plating solution, gave such contradictory values that further experiments were abandoned, with a verdict of not-proven.

*Effect of Annealing Chromium Plate.*—The hardness and brittleness of electro-deposits of iron and nickel are lessened by heating to redness, and it was thought that similar effects might be produced on chromium plate. A 48-hour deposit of chromium on a thin sheet of copper tested #89 on the Shore scleroscope, but after annealing at a red heat for 15 minutes tested only #36. It is evident that one of the useful properties of chromium plate, viz., its resistance to abrasion, is lost by heating to high temperatures.

*Effect of Superimposing Alternating on Direct Current.*—During the last ten years many claims have been put forward for the beneficial effect of using alternating current superimposed on direct current for particular cases of electrolysis, and a number of patents have been taken out for such use. Information that this combination gave better results than direct current alone in chromium plating proved incorrect. No improvement could be found.

*Use of Kerosene to Prevent Fumes.*—A layer of kerosene has been used for many years to prevent foaming or spray from industrial solutions, and several persons have recommended its use in chromium plating. The writer has tried it and recommends it for temporary use where the expense of an exhaust system is not warranted. One would expect that passing articles through the kerosene would prevent adherence of the deposit, but there is no trouble on this score. The violent evolution of hydrogen that accompanies deposition of chromium makes the chromic acid bath one of the best combined cleaning-and-plating solutions so far used. It should be remembered that not only is kerosene inflammable, but the bubbles that come from the cathode are filled with hydrogen and those from the anodes with oxygen, and when the two mingle there is danger of a violent explosion if the mixture is ignited. Breaking of the circuit should be done at the switch and not at the cathode rod! No heavy oil should be mixed with the kerosene else it may not be wholly removed by the hydrogen

and cause spots bare of chromium, and also by an increased viscosity make a dangerous foam on the surface of the bath.

*Determination of Current Efficiency.*—When platinum is not available as the cathode on which to deposit metal for finding the efficiency of deposition, copper is usually used, and several investigators have used copper cathodes in the chromium solution. Copper is unsuited for this use in the chromium solution since it is attacked. Iron or steel cathodes should be used instead.

*Stripping Chromium Plate.*—Chromium plate is easily stripped either by use as anode in a chromium solution kept for this purpose, or by the use of hydrochloric acid. The first method may be used for stripping from iron or nickel plate without injury to the finish, but in stripping chromium from copper and brass there will be attack of these metals if the article is left in the bath too long. The writer prefers hydrochloric acid for stripping chromium from copper or brass, and if about 2 volumes per hundred of formalin be added, chromium plate may be stripped from steel without marring the polish. Various dilutions of commercial hydrochloric acid (muriatic acid) have been recommended, and almost any strength may be used, but the more dilute the acid, the slower its action. The pickle used for stripping chromium from steel must be free from copper.

*Use of the Doctor.*—In the old days when articles were plated by the dozen instead of by thousands as at present, and a large percentage of the day's output received individual attention from the plater, the "doctor" was often called on to save replating some article which had failed to cover in one or two spots. For the benefit of the younger members present, who probably have never heard of a plating doctor, it may be well to say that the doctor referred to consists of a small anode wrapped in cloth or a piece of sponge. This is dipped in the plating solution, connected to the anode rod by a wire and touched to the bare spots on the object, which is connected to the cathode rod through a suitable rheostat. Such old time doctoring was unsatisfactory for it did little more than give the color of metal, for where the original plating had taken an hour or more, the plater had neither the time nor patience to put on more than a fraction of this thickness with the doctor.

Because of the short time required for ordinary chromium deposits, chromium plating lends itself especially well to use of the doctor and because of poor throwing power needs its appli-

cation more frequently than any other electroplate. Two minutes' use of the doctor puts on a deposit of chromium quite as heavy in most cases as the original plate. Because of the oxidizing power of the chromium solution the chromium doctor needs a suit of asbestos clothes instead of the cotton worn by the old-time plating doctor. The writer uses a strip of lead or steel covered with asbestos sheet tied on with asbestos twine.

Dept. of Chemical Engineering,
University of Wisconsin.

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## NEW THOUGHTS AND THEIR APPLICATION IN THE LACQUER INDUSTRY

**By Mr. Leo Roon, M.Sc., Technical Director, Roxalin Flexible Lacquer Co., Long Island City, N. Y.**

MR. LEO ROON: "When I sent the title of the proposed paper forward to Mr. Barrows, I must have been in a particularly ambitious frame of mind. I did not realize for the moment the broadness of the scope. Therefore, with due humility to the vastness of my subject and in consideration of the short time allotted me, I propose to speak at this meeting on flexibility, just one little thought, very important, though much neglected.

"In many industries flexibility and adhesion need have nothing to do with one another, but in your particular field, the metal industry, they should and must be united to yield the results which we all seek. We have prepared several metal plates to illustrate different types of flexibility and adhesion commonly found in practice.

"Plate No. 1. You will note that the yellow pigmented lacquer peels off readily in sheets, but these sheets themselves are perfectly flexible and the film itself is tough. This is an illustration of flexibility with toughness without adhesion.

"Plate No. 2. This yellow pigmented lacquer is soft, and will remain so. Your finger nail takes it off like cheese, but it is flexible and sticks well to the metal. The old timers will never forget the old castor oil bottle or can. A little flaking, then the bottle, and if the dose was too much, this shows what happened. So we have here an illustration of flexibility without toughness or wearability with adhesion.

"Plate No. 3. This yellow pigmented lacquer looks good, but on bending the plate, the finish cracks. Scrape it with a knife

and it flies off. The older it gets the more brittle. The finish is satisfactory for cheap work where color coating to last until it reaches the consumer is sufficient. That is a common condition of temporary flexibility, temporary adhesion.

"Plate No. 4. This is also a yellow pigmented lacquer but so formulated that you can bend it any number of times in the one place, in fact, until the metal cracks, but the finish does not chip or flake. It has toughness to the point that it can be readily buffed with rag wheel and limestick as you will note on these compacts.

"This same type lacquer has perfect adhesion to glass as you will note from these glass articles, and the finish feels as hard as the glass itself.

"You will also note from these metal pieces that stamping and drawing operations do not affect the adhesion. Tests show that these brass pieces can be stamped and drawn again after a lapse of one and a half years, and so we may say that lacquers formulated in this manner possess ideal properties for metal finishes as they combine permanent flexibility, permanent toughness, and permanent adhesion.

"The sample plates were done in pigmented lacquer so that they could be seen readily, but the same situation applies in the clear lacquers, and we have several practical applications shown here.

"A simple method for determining whether a lacquer will stand a stamping and drawing is to place the finished piece in an acid copper plating bath, then rinse dry and examine for copper deposited on the lacquered face. If the color of the metal makes it difficult to detect, dip the piece in a cold sulphide solution and the black copper sulphide will be readily detected if the lacquer film has failed.

"Please bear in mind, however, that while this type of lacquer has this adhesion to a wide variety of metals, and thereby eliminates the necessity of stacking two to four different types of lacquer, and reduces the chance for error on the part of the operator, it is not a cure-all or a magical substance.

The fact is, that the requirements of manufacturers even in the same industry vary considerably. Their local conditions of preparation of their work, spraying, handling, drying, etc., vary even more, and in the proper formulation of lacquers, therefore, the individual requirements must be taken into consideration from the scientific and practical ends, if you wish to get the best pos-

sible results. If your lacquer man understands the theoretical phase of his work and feels at home in a pair of overalls, he can understand your plant operating conditions. Consult him as you would your physician or attorney, tell him the whole truth, let him diagnose and prescribe, keeping in confidence such phases of your work as you specify.

"Studies of such nature have made possible unusual developments such as you see here, and there are many others which we were unable to get permission to show, as the manufacturers asked to keep them confidential.

"Like the rest of us whose business it is to work, eat, sleep and even dream of lacquer in all its diversifications, I am thoroughly imbued with the fact that lacquer manufacturers have only scratched the surface in the field of protective and decorative coatings. May I, therefore, say a word in conclusion to any purchasing agent, superintendent, or foreman here who may be classified as hard-boiled by the swarm of lacquer salesmen who call on him. These points are:

"1. The biggest developments in the lacquer industry have been made principally in the last five years.

"2. Bigger and finer developments in this infant industry are bound to come from progressive lacquer houses.

"3. Progressive consumers of lacquer will get the first benefits of co-operation with progressive lacquer manufacturers, the others will follow.

"4. Therefore if a lacquer salesman shows you something really new and different, please don't give him any one of the ten accepted stalls known to all lacquer men, but listen to him, sift him out from the others and give him the opportunity to prove his claims in a practical way. There is every chance that you will both benefit by such an evidence of progressivism." (Applause.)

CHAIRMAN SMITH: Is there any question you would like to ask Mr. Roon?

MR. SERGENT: Does the different colored pigment have any effect on adhesion?

MR. ROON: It does to a degree, but that is merely one factor.

QUESTION: I would like to ask Mr. Roon if the glass articles are all primarily coated before pigment lacquered.

MR. ROON: No, all the pieces you see are given one coat of lacquer directly on the glass. No prime coat is applied at all.

MR. GRUND: I would like to ask how the adhesion holds to a cadmium plated surface.

MR. ROON: We have never tried it. I would be very glad, however, if you would like to submit pieces of cadmium plated metal to use, we will work on that particular proposition.

QUESTION: How much heat does lacquer take without discoloration?

MR. ROON: I would say if you were to heat these lacquers here for a period of a couple of hours at 150 to 175 degrees Fahrenheit, there would be no discoloration. These are not heat-resisting lacquers by any means, and we don't claim that they are such but there are heat resisting lacquers made both in the clear and pigmented lacquers to meet those conditions.

MR. KENNEDY: I would like to ask if any previous chemical treatment is necessary before the application of this lacquer.

MR. ROON: No, sir, no chemical treatment other than to be absolutely sure that your metal is clean and free from grease and dirt.

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## THE PLATERS' POSITION IN PURCHASING

**By Mr. Van Straaten, of the International Chemical Co., of Philadelphia**

We all know that in the past few years there have been very many developments in the science of electro-plating, and that the researches of the scientists have brought many important developments. It is very interesting, though, to look back upon them and note their importance and results. As to their importance we can have very little doubt but as to the results, many questions might be raised, chiefly due to the query as to whether or not the plater is benefiting to the highest possible degree from these developments. In other words, are these new discoveries actually reaching the man who is most interested in their use and application?

The plater has three possible sources of information as to the use and development of new materials: the scientist, the brother plater, and those firms that specialize in furnishing the plating industry with its material and equipment; the scientist and the plater disseminate their information through trade journals, personal contact and conventions; the plating supply house, on the other hand, is entirely dependent upon its advertising and its salesmen. The scientific development work of some of these supply

houses is just as important in the field of plating and manufacturing as those of the unattached pure scientist. Many of them retain large research staffs and especially trained men purely for the purpose of making new discoveries, finding new materials and new ideas for your exclusive use. It is very true, however, that despite all that they do for you, in the minds of many platers the developments of these houses are looked upon with less respect than the developments of the scientist or the plater. It is unfortunate, but in many cases we find that it is true.

There are probably two reasons for this: one, the fact that in the mind of the plater it cannot be overlooked that the supply house in bringing forth a new material or a new idea is undoubtedly impelled by the hope of financial gain.

The second is that in the past the much flaunted developments of some of these houses have proven to be flat failures.

In regard to the first influence that the supply house in bringing forth a new material is doing so in the hope of financial gain, it is perfectly true. They are. But that very same thing applies to the house with which the plater is associated, and makes the development and the discovery none the less meritorious. These firms spend large sums of money to retain their prestige and their years of standing, and they are very jealous of those assets and will do everything possible to justify the confidence placed in their name. That being so, there is no reason in the world why their discoveries and the things they are bringing forth should not be just as important and just as valuable to the plater or to the firm that they are trying to introduce this idea, as those of the unattached scientist or those of the brother plater.

In regard to the second influence, as to past experiences on the part of these people, it is true that in the past there have been many failures; even today it is a very common thing for a representative of a house to walk in to a firm to sell them, glorifying his product with his flags flying and his drums beating that may or may not have merit, and I think most of you are thinking of past experiences and saying "mostly not." But it is a very serious question, and it is very important and it does require and need a great amount of your thought.

Each and every one of you are vitally interested in any new developments that may help you to improve your conditions or to make your work easier and reduce your operating cost in every possible respect.

Yet, past experiences have caused you to despair of present-day claims of many representatives. You have despaired to the point of throwing up barriers, barriers in your own minds in the form of doubts and physical barriers in the form of preventing your being seen by these representatives in most cases. Your associate purchasing agent and in many cases the superintendent has also developed these barriers. Great doubts exist in their minds as to claims that are today being made regarding new discoveries and new developments. The only danger that possibly arises is this: isn't it possible that with that state of mind existing, you may in many cases overlook and pass up a very good idea or material that would help you a great deal and be of great value to you? That, briefly, is the problem that exists. You recognize it, and I will say very frankly I don't blame you a bit. You are perfectly right in feeling as you do. At the same time though I believe you will agree with me from your part that it is a very serious problem and if possible something should be done to correct it.

Up until the last decade the plater saw every supply man that came into the plant. He was welcome, due to the information he had to give. The development of the science of plating in the States was greatly due to the supply man because he carried information from plant to plant as to what was being done in other plants, and thus aided everybody and everyone benefited. But, during the past ten or fifteen years there came the era of the purchasing agent, really an outgrowth of the war.

He states on one side that he does all of the buying, that he orders whatever the plater requests. However, this question arises, if he is averse, as in many cass, to allowing the plater to see the supply man and being interviewed by him, we wonder how it is possible for the plater to be fully aware of the best things for his needs, for it is an undisputed fact that the scientific development of plating or any other operation can only be clearly presented and understood by the plater and not through second-hand information as would be the case in transmitting such developments through the purchasing agent.,

I have discussed this problem with numerous platers and purchasing agents. They admit it is unfortunate. They feel that much could be accomplished if they could place the necessary amount of confidence in the sincerity of the representative that is calling upon them.

This opens up a nice question that was discussed with me by

several supply men and platers just within the past two or three days. I don't intend going into it as to the question of ethics of the supply salesman. That is something that rests entirely with the management of the supply house. It is up to them to see that their representatives are properly equipped to properly present whatever message or information they may have to the house that they are trying to help. The answer as far as we are concerned logically seems to be: a basis of mutual understanding and respect on the part of the purchasing agent, the plater and the representative of the supply house. When the purchasing agent realizes that he is dealing with a firm, this representative upon whom he can depend, he will without a doubt allow this representative and this plater to discuss their problems and arrive at some satisfactory solution of them. That is rightly so.

The plater is the responsible party, and being responsible for the work should be just as well informed and have the right to dictate what he wants the same as any other executive.

To benefit from the advantage of the supply house whose confidence he has, the plater should have an understanding with his superintendent, production manager, or purchasing agent that whenever such a representative calls upon his firm he will be allowed to interview him. It will be of use. All progress is beset with disadvantages. The transition from that peroid in which the plater interviewed everyone to the condition which exists generally today, from which it is almost impossible to see him, is a great one, and only time will safely correct it. The plater owes it to himself, to the science of plating, and to the firm with which he is associated to instill mutual trust in himself and in the purchasing agent so that the boss will be impressed with the fact that the plater should and must see the representative supply men.

In the field in which I am active many problems constantly present themselves. If it were possible to develop a cure-all cleaner, these problems would never exist. But we all know and feel that that day never will come. In the cleaning field the problem, though, of new developments at this particular time, is very vital, due to the fact that cleaning every day is becoming more complicated. The cry for production, the lowering of costs, the use of new metals in which we are having the trouble of spotting out, the handling of particularly soft metals, such as alu-

minum, zinc die casting, cause it every day to become more and more a problem and question.

There have been brought on the market in recent months materials used for the purpose of cleaning that have never been used before. They have made very rapid strides. More research is being done along those lines, and I dare say that with the field open today in the next twelve months there will be brought to the attention of the platers new methods of cleaning metals that a year or two years ago we would have thought to be impossible. The handling of soft metals has been greatly improved. It will be improved more than that within a very short time. The handling of metals, very difficult and heavy oils, and greases, removing them in a very quick time in comparison to the time that it has been done in the past, great strides have been made on that.

Just from that angle in the field in which I am active, not even considering the developments of other supply houses, of which there are many, brings that problem to a focal point and should impress upon us all the necessity of some methods whereby the developments of these houses are brought just as clearly to your attention as the developments of the scientist or the plater. It is very necessary for the reason that they are very important in their field. A healthy relationship and only that will serve to bring these and all similar developments to your attention, and all that I or anyone else can ask is that you give it some thought and try and establish a more healthy relationship than has existed in the past. I thank you very much.

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## PHILADELPHIA BRANCH

Regular monthly meeting of Phila Branch was held at the Harrison Bldg., U. of P., March 1st, with Pres. Gehling presiding, with a good attendance.

Two applications were received. Mr. Hirsch and Instructor W. M. Scott made a favorable report on the work being done in the chemistry class, which is now analyzing chromium solutions. Pres. Gehling strongly appealed to the members to join this class and explained how beneficial it will be to each member.

This being Question Box Night the meeting was turned over to Mr. Willard M. Scott, who answered a number of questions on nickel and cyanide solutions, which made this portion of the meeting also very profitable.

Philip Uhl, Secretary.

## PHILADELPHIA BRANCH—(Continued)

## ROUND TABLE TALK CONDUCTED BY MR. SAMUEL BARR

### FEBRUARY 1, 1929

Credit—The Quaker City Platers Reminder with extract.

Before I start on my talk on the plating problem I would like to show you some instruments here that we handle in our plating department. This is what we call a "Bernal" spring, that is used on an instrument for testing the heart. It has two rubber tips placed on the end, and rubber hose. Now, in plating these, if your bath is not right the nickel will peel off. If the plating is any way hard or brittle it will show on that spring, so you can readily see the importance of having a bath in the proper working condition for that purpose. Then another important feature in finishing work for plating is the importance of removing marks and getting it properly finished. There is an instrument, you can see the color on it when it is finished, and the higher the finish the better the plating shows up. Most places will finish it rough; the plating is heavy enough on it to stand buffing.

Here's another instrument, a pair of scissors used for cutting tissue and so forth. When we plate them we leave the blades together, and after they are plated it is necessary to remove the plating to sharpen up the edges again, and if the plating is not properly put on it is liable to peel in grinding, so that's another test it must stand.

Here's another instrument probably you will all recognize. You've heard, probably, of Dr. Jackson's work at the Jefferson Hospital. If a patient is affected with something in the stomach, like a disease, tumor, cancer, or anything like that, it is necessary for the physician to go down in the stomach; they put this down and cut a piece off the inside of the stomach. You can see how sharp it has to be on the cutting edge. In plating that instrument we leave the jaws closed. Any plating on there interferes with the working of the instrument. These clips are put on here to keep it together. There are two of them. They are plate separately and rings put in to separate them, so the plating will get in between. Now from here out the instrument is not plated at all. They won't permit any plating to be put on; the plating is liable to peel and soak into the blood and cause blood poisoning. These two jaws are blue steel.

These are some of the instruments we handle and, of course, you can readily see you can't use a very high current density; liable to burn it, and it must be plated very slowly, giving it the necessary time.

#### An Apparatus to Obtain Metal Content

I have here another apparatus. It looks rather crude, but it answers the purpose. Before I go any further on this I will explain. This instrument that I have here was made from parts of things that we have in the factory, and I assembled it together to get this apparatus. This here is part of a bellows used by dentists for pumping air, and these are brackets that go on cases to keep the lids open and to keep them in perpendicular position. These wires are simply scrap that

I got. Now, the platinum annode is a piece of scrap platinum, and in that way I was able to get a piece of platinum annode. That measured about one inch square. That is what I used for an annode. I imagine the best annode would be a spiral wire, which would work better. While this works very nicely, it is not all it should be, but I get good results and in that way I am able to determine the metal contents.

These are eye-droppers that hold 1 c. c. These come in test cases that doctors use for testing one's blood. This I made myself by heating the ends and closing them up. I use that to stir it with. Now, in starting off the apparatus, I use 37.5 c. c. of solution, that is the one-hundredth part of a gallon; or you can use 40 c. c. and multiply that by 25 and that will give you a thousand c. c., and you can get your ounces per gallon from that. It doesn't make any difference which method you use, it is a matter of convenience for the individual plater; but in making your tests frequently you can formulate a table, that is, by so many hundred milligrams per 37.5 c. c., and you don't have to carry it out the full example to get the amount of metal in your solution, and that saves you time. Now in starting off with the test the hundredth part of a gallon is diluted up to a hundred. In other words, this beaker is filled up to about half an inch of the top. Then, after that is done, you add in about a gram of ammonium sulphate to your solution. Then, after that starts to work quite rapidly, it will get heated up and will become acid; then I use a few drops of ammonia to neutralize that and hasten the action and it is quite surprising how hot that gets. I use a high current density and probably eight volts. I use the high voltage to hasten the analysis and it gets quite hot, and I keep adding that ammonia until it stops getting acid, and that is the point I have come to the conclusion, that the metal has been all absorbed, and if you have any doubts that the metal wasn't all withdrawn, you could check up with a chemical method, which I have done at different times to make sure that my analysis was correct.

I simply give it its time; it takes about two hours. Start it off, go about your other work if necessary, and look at it occasionally, and in about two hours it is done. I weigh the cathode before and weigh it afterward, and take the difference in weight. In some of the analyses I made, taking the ordinary bath that I use for this work, double nickel salts, 10 ounces; single salts, one ounce; boracic acid, two ounces; water, one gallon. Now, on a bath I usually, if I have the time, I will make an analysis on the bath when I first make it up, and then I will check up on it later on and see how it maintains, and from that I can judge what it requires. Now, a bath made up of 10 ounces double, one of single, two of boracic acid, and water one gallon, that will analyze around two ounces or 1.9 ounces per gallon.

Now, you might think that, after a solution has been used a considerable time, especially with annodes with impurities, that you might find iron, and there is no question that there might be some iron deposit along with your nickel, but, of course, for plating purposes I

don't think that makes a whole lot of difference. You probably could add some chemical to remove your iron, and in that way you would get your proper metal content of nickel.

In making up a new bath it don't usually work satisfactorily, and in time they have got to be modified, and I am governed mostly by the work and what it requires. Of course, after a time it does need some ammonium chloride in order to get the proper annode corrosion. The bath I use for die casting work: Nickel sulphate, 12 ounces; sodium sulphate, 12 ounces, and that could be raised to 14; ammonium chloride, 2 ounces; boracic acid, 2 ounces; water, 1 gallon. When you add that, it is very important to use sodium perborate. The work in that tank has probably run about seven minutes. Our regular work in the tank is one hour. There is some work we cut down and run 45 minutes, but usually it is an hour.

The Ph acidity I generally run around 5.8, 5.9 or 6.0. That is for acidity. I have run it around 5.4, but that was too acid, doesn't have the proper conductivity, and I find better results come around 5.8, 5.9 and sometimes 6.0.

In running the bath in a different analysis that I have made from time to time, they have run around 570 milligrams; that is, for 37.5 c. c. of solution; 550 milligrams, 580 and sometimes up as high as 600 to 630, and about the lowest that I have used is around about 530 milligrams. That is a little over a half a gram per 37.5 c. c.

The voltage in doing this work is very low, probably don't run more than one and a half, very seldom two. The machine gives four volts at the machine, but at the tank the voltage would be around one and a half. I have no volt meter on the tanks, but we tell mostly by amperage. You can very nearly judge if your bath is losing conductivity by the amperage and the general line of work that you are handling. If you are handling it every day, you can very nearly tell you are not getting proper current for your bath if you are not, and the only thing I am concerned about is when I know the machine is giving the proper voltage I know I am getting it at the tanks, provided the connections are properly cleaned, which we take good care to see is the case.

I find, in making up new baths, they never do work properly and satisfactorily until they are aged. You can't really give any explanation as to what a bath will really need. Your experience teaches you from time to time, and, in other words, the bath seems to get electrified, or probably that is not the proper term; but it gets aged, which helps it a lot. Years ago, in order to age a bath, I have put in a couple of iron sheets and run it maybe for two or three hours. I know I had difficulty in getting die castings clean in the beginning. I blamed it on the cleaning process, but I don't do it any better now, and I don't get near the trouble now as I did then. The fact is that the bath is aged up, and probably with the addition of sodium perborate it has eliminated the peeling, owing to the high current and the short time it has to be in the bath.

Another important thing is the temperature, especially during the

cold weather. We usually heat ours up on Monday morning, and, not having any heat in the factory over Sunday, they are apt to get chilled, certain portions are taken out and boiled up, put back through a filter, so as not to stir the bath up. Another way I find in handling a bath, especially in hot weather, you couldn't do it very well in cold weather, but on Saturdays you take several bags of double salts and hang that in the bath over Sunday. Then sometimes it will take it up and sometimes it won't. It won't take up any more than it should, but it seems to me the most logical way to apply it so as not to get your bath too dense, so it won't crystallize, and it will crystallize more in cold water if you have more ammonia and not enough metal content, and you won't even have the density in your bath. I was never able to carry very high metal content in the bath on account of the smallness of the work. I got better results with two ounces per gallon than any other amount I have ever been able to use. I never made any attempt to carry much higher than that. The fact is that your small screws in tight-fitting joints, you get too much plating on there, and then there is a kick; they have to remove it, and they don't fit, and then there is a complaint. So long as you get enough to stand the buffing wheel, especially over sharp edges, without being cut through, there doesn't seem to be any trouble in having it stick without peeling.

So much for the nickel. Now, I am going to jump from nickel over to silver. I had some experience some years ago with silver bath carbonates and I had quite some difficulty in removing them, and one of the chemicals I used was hydrocyanic acid. It is so much diluted that you have to add such a large quantity to your bath to remove the carbonates that it won't have much effect.

Then there is another chemical that could be used; that is calcium cyanide, and I thought that would give me the results. You mix that up and it forms calcium cyanide, and when you add that to your bath you get calcium carbonate and a white precipitate at the bottom of your bath. That was not satisfactory because we were still working with hydrocyanic acid and you didn't remove much, especially if you had much of it in your bath. That went along for quite a while, until Mr. Hogaboom had discovered a method, I might say accidentally, in the freezing process. He had a bath—I have his article here—and by leaving the windows open in the plating room over Saturday and Sunday, when he came in on Monday the bath was quite covered, as you can see by the picture these carbonates had formed. Now, the carbonates are taken out, shovel or any other method, and put on the filter. Must keep them cold, and then you wash them with cold water, and in that way you get most of your silver solution out of your carbonates. Of course, you will dissolve some of them and they will go back to your solution, but you will get out the majority from your bath and probably you won't lose much of your silver bath. I had removed around about ten pounds, I suppose, out of a twenty-gallon solution, and I had washed them thoroughly, and I made an analysis to find out what the metal content was, and it wasn't worth while

trying to get them out; that is, the expense you would be put to in removing them would be more than you would be compensated for in the silver. But I was told we could use those carbonates as a flux in melting silver and it would absorb whatever silver was in the carbonates, and in that way it was an inexpensive way to remove the silver; but it was doubtful whether there was any amount in there to remove.

I have a sample here, about a four-ounce bottle, and you can get some idea of the amount of carbonates in that bath. There they are in the bottom. Notice how they form up. You must keep them in the cold, otherwise they will dissolve again. (Pours liquid off into another bottle, leaving carbonates in original bottle.)

I have some more here in the dried state. In the heart they are not quite dried and you can see the formation of them. Now, after that dampness in there has been dried out, it goes into a powdery form. That was taken out of the same bath that this sample is from. That is the method Mr. Hogaboom used. I thought it would be a very good illustration to bring that down here and let you see how it is actually done and how they look. Probably you have read about it and have often wondered and probably some of you have never had any trouble with carbonates.

If there are any questions about anything I have overlooked, if I can't answer them, probably some of the other members will. Of course, my experience is only on surgical work, and that has been over a long period.

Q. Do you strip that gauze cathode before you take your metal out of your solution?

A. I give it a slight dipping, but when it gets too full of nickel I throw it aside and make up a new one.

Q. How do you weigh it?

A. On a balance. I weigh it before I use it and weigh it afterwards, and the difference of weight is the metal contained in the solution.

Q. Do you lose any of the gauze when you are stripping it?

A. Well, I dont strip it. You see, I weigh it first; I weigh it before I use it, and then I weigh it after I plate it; then I take the difference in weight, so anything you take off afterward doesn't make any difference. When this gets too bad, with too much nickel on it, you see it doesn't plate evenly, and when you go to strip it, it goes to the bottom, plates heavier on the top. That is why I say probably another apparatus, different in shape, to get a more even deposit, distribution of current, would be better. Where I got this idea: when we first came to the University to meet we had Dr. Smith to welcome us, and after we were here some time we were taken back in the laboratory there, and they have apparatus there working on this principle with a platinum anode, and there is a mover attached to the spiral which revolves that; it is agitating it, and they use a high current density, and on top of that platinum dish is a glass slab or cover to avoid having the solution splashed out and lost. That's what they use—a platinum dish, and the metal can be very easily removed. Of course,

with this you can't do that so well, and it is inexpensive, so that you can throw it away and make a new one.

Q. How accurately do you weigh that?

A. Those balances I have are small scales and they will weigh about twenty milligrams.

Q. What is the metal content of that die-casting solution?

A. Oh, I meant to mention that. I'm glad you asked that question. The metal content of that bath, if my memory serves me right, I think it is three ounces.

Q. How do you determine the Ph?

A. Well, I have used the method red and I'm using the purple now. I have the bottle rack with ten bottles in it, and the black square block, and I use that for testing the Ph. By the way, Dr. Blum was here from the Bureau of Standards some few years ago, and he visited about four plants in Philadelphia at that time, and that was when he first brought out the Ph acidity by the bottle rack method, and our plant was one of them which he installed it in, and as a result of what we were to give reports of what was the proper Ph acidity and the work done at that time. He did that to get data on the different classes of baths that were operating under the proper acidity. I don't know what other plants it was installed in at that time, but I still follow that out.

Q. How do you tell when all the nickel is deposited in that?

A. Well, in starting off, I have a piece of Congo Red paper on a small pair of tweezers. Then I add ammonia; after that is operating awhile the nickel is being absorbed and as it is being absorbed the solution has a tendency to become acid. As more of it becomes acid it shows an increased resistance, and in order to overcome that I add more ammonia. That forms ammonium sulphate, and I keep on doing that until the Congo Red remains a permanent color, and that is the conclusion I come to, that the metal has been all absorbed. Of course, if there is iron in there, you will deposit it, too. There is a chemical that can be used, but I don't go that far into it, but I would like to hear it.

MR. SCOTT: In taking the sample and putting it in your beaker, don't let it get acid. In that way you won't deposit your copper or iron, and then don't use eight volts. We only use three volts when we agitate that. Now, instead of using eight, use about three, because we only use three volts when we agitate it.

Now, if you use too high a current, you will find out your cathode will build up not only with metal, but with other chemicals, by leaving it run too long and too high. Now you can bring that out, that cathode will come out so bright that the nickel will be bright.

MR. BARR: That was the difficult part I had in making the analysis. Around the upper edge she does go very rapidly and at the bottom it is very light. That is why I say that if you do much stripping the result is your wire gauze is eaten away. I've started it off with a low voltage and made it slightly alkaline and run it that way, but I was rather impatient and wanted to hurry along and switched

over to the higher current to speed up. It probably wasn't the best thing to do, but I wanted speed. Now, Mr. Scott, if I were to use the lower current density you say, three or two volts, would I be able to accomplish the same results in about two hours?

MR. SCOTT: No; you take too large a sample. You would have to take a smaller sample of your plating bath. You are taking 37.5 of your c. c. where you should take about two.

MR. BARR: The reason I take the larger amount instead of the smaller amount, you've got to build it up to a gallon; there is a considerable difference there. That is why I use the one-hundredth part of a gallon for that reason. If it isn't quite accurate, there wouldn't be such a great difference.

MR. SCOTT: And then to make sure your nickel is all out of there, just take a gm. dimeythl-glyoxime and dissolve it in an ounce of alcohol and use as an outside indicator, and if there is any trace of nickel it will precipitate pink, and unless you get all the nickel out of there you will get the bath uneven.

MR. BARR: Ammonium citrate was recommended two years ago to keep the bath clear. It has a tendency to dissolve the iron in the bath; that is, if your cloudiness is due to precipitating of the iron out of your annodes, and certainly will clear the bath up, but if you get very much of it in there, it makes your plating very dull, and we don't usually want that kind; we want it fairly bright, not too bright, to be brittle, but so it can be easily buffed. If it was possible that we had one kind of work, steel or brass, we could easily make up a bath that would suit that particular class of work, but when you have an instrument with steel and brass on it, like this, solder, too, you can't leave it in the cleaner too long; it eats the solder, and if you put it in your water tank and that's too strong, that affects so you've got to have a bath that will cover all classes of metal, and the reason I used ammonium citrate was to stop that cloudiness and get a clearer bath and probably it wouldn't have that yellowish smut you sometimes find on your work that settles from your bath being stirred up, but I have discovered that and find I can get along very well without it, and you get a dull deposit. Then I got to use magnesium chloride. I have stopped that. Then I started to try nickel ehloride. I sort of got away from that. I am not using it lately. I find that it gives a very dull deposit, that is with our work, anyway. There isn't much drip to our work, and by hanging in a couple of bags of double salts on the week-end, that takes up from your drip. I carry a very large annode surface, considering the size of the work, and that helps to keep up the metal content.

Q. How do you tell the changes in solution by the amperage?

A. If you are running work where you ought to get probably 25 to 30 amperes to that tank load, and it is not holding up to that, and as the amperage means the deposit of metal and it doesn't show the amperage necessary for that amount of work that you have in there, you are not getting the proper amount of nickel.

Q. Then when your amperage falls you add more metal?

A. Not necessarily. You might have enough metal, but not enough conductivity.

Q. How do you ascertain which it needs by a fall of amperes?

A. If you have any doubt, then I will make an analysis.

Q. Why do you add that ammonium sulphate when you make that analysis?

A. To increase conductivity. When you dilute it down it isn't very good. I am not sure, but I think it was Dr. Lukens who recommended phosphate of soda, but that didn't appeal to me, so I got to using ammonium sulphate, which the bath is made out of, and I don't measure out any quantity; just probably half a gram, and stir that in hot water and pour that in and start it off, and I found that shortened the time in making the analysis.

Q. How do you add your sodium perborate?

A. By the method recommended by Mr. Proctor I take six ounces Troy, because we haven't any other weights in the factory but that, and I take an agate or porcelain pitcher, gallon capacity, and I put the six ounces in this pitcher, then I fill the pitcher up with cold water, hang that in the hot water tank, on the side, then I stir that until it is all dissolved; in that way I don't have any danger of getting it too hot. I take it out and puit it in the cold water tank and cool it off immediately. Now then, in adding hydrochloric acid I start off with using the color method, the purple to get the proper acidity, and when I found the proper amount to the six ounces, I put a label on the bottom, putting on the label, "Six ounces of sodium perborate," then adding 145, I think c. c., of muriatic. Now I am not satisfied even with that, because in heating up the perborate sometimes you may get a little bit more or less, so in order to guard against getting too much muriatic, I use Congo Red paper and use that until I get a slight coloration on the red and re-pour some of the perborate solution back and then when I get it up to the proper acidity I dump it all together. In that way I don't get it too high, but I believe Mr. Lumbeck keeps his perborate at slightly alkaline, slightly on the alkaline side. It seems he gets a slight cloudiness.

MR. LUMBECK: The acidity of my bath counteracts that; it is almost neutral.

MR. BARR: Well, I think that's about the safest plan to get your sodium perborate solution as nearly neutral as possible, and if your bath gets slightly alkaline you can easily make it acid by adding, and I use sulphuric usually.

Now, in mine, I think the bath is around 300 gallons; maybe every two weeks or so I add 30 c. c. of sulphuric acid. That seems to be about the proper amount it requires to keep it at the proper acidity. Run it around 5.8 or 5.9 once in a while to 6.0.

Q. How do you control temperature in that bath?

A. Don't make any attempt to control it at all. If you wanted to do that it would be necessary for you to put a coil in there and have a thermostat to control it. It improves the conductivity of the bath by heating it up, and while you might have trouble in peeling (I have

had trouble with peeling), and when I came to find out, the bath was too cold, and by heating it up it softened up the deposit. And then another thing: I think it is a good principle to boil it up occasionally, working the bath day in and day out, and not boiling it up occasionally, it doesn't seem to work right.

In this die-casting solution we had occasion to heat it up, and you'd be surprised at the amount of yellow precipitate that formed in there, and I collected some of it and made analysis on it and found it was iron. Now, to make the analysis on that for iron I have learned in making analyses on silver bath for metal contents that you use iron as an indicator and use sodium sulphate of cyanide to take up your metal, and when it comes to the end point the iron will show a pinkish color immediately. Well, I thought over that and I came to the conclusion that I could probably use that method in determining whether this was iron or not, so the thing is to get this precipitation dissolved, and what I used for that was nitric acid, and I dissolved as much as the acid would take and I got a clear solution and poured it in another beaker, and I added the cyanide and she turned the reddish color, and in that way I knew it was iron. When I boiled that bath up I got a considerable amount of that precipitation. Whether it was from the annode or what, I don't know.

MR. SCOTT: The only difference in the hot and cold is the cold offers a great deal of resistance and the Ph varies according to the temperature; you precipitate all that iron because irons stay in alkaline solution.

MR. BARR: I probably could explain how that got in there. In some of our die-casting work they had a tendency to burn. I hung a strip along the bottom, a piece of sheet iron about an inch wide, and I left it there, thinking there would be enough plating without being attacked by the solution. Of course, we used the solution every day, and over this period of time it was in there for quite a while, and when I went to get the strip it was pretty well eaten up, and I imagine it was where the iron came from.

Q. What harm do the carbonates do in the silver solution?

A. Well, I don't know whether I am at liberty to say, because there are so many arguments pro and con and so many differences of opinion as to what it does do, but if you ask me my personal opinion, I think that they have a tendency to increase the resistance of the bath, and, if removed, that the bath will have a better conductivity and you could run at a much lower voltage.

Q. On your die-casting, how do you compare the current density with your other tank?

A. On the die-casting I have a volt meter on that. I use that on the die-casting work alone.

Q. How does that compare with your other tank?

A. Two volts, or higher. Sometimes it will run pretty near three volts. Naturally you've got to give it voltage when you are only running it seven minutes.

## ST. LOUIS BRANCH

Our annual educational session and banquet held on February 2 was a very profitable and enjoyable affair.

The educational session at 3 p. m. was presided over by A. Riefling, our librarian. "Pitting of Nickel Solutions" was the subject of a talk by Dr. Stout of Washington University. Naturally this subject came in for some discussion.

The "Open Question Box" conducted by Geo. B. Hogaboom, was filled to the limit. The limit was time, with only enough space between sessions to move from lecture room to the banquet hall. This feature was indeed great. It opened up a variety of subjects for discussion, giving a chance for all to take part. Mr. Hogaboom handled every situation as only a diplomat can. We regret that George cannot be with us in April. We may date him up for next Christmas as we understand that is an open date with him.

We appreciated the presence of C. H. Proctor, founder of our society; Dr. E. M. Baker of University of Michigan, Dr. H. L. Ward of Washington University, F. J. Hanlon, editor Monthly Review, with R. J. Hazucha and others of Chicago Branch, and many visitors; all these helped to increase interest, and they entered right into our discussions.

The evening "Session" under leadership of our permanent banquet committee chairman, E. J. Musick, was the best we ever had. Ed, just has a way of arranging for and conducting these affairs, without the necessity of assistance.

The attendance this year was largest we ever had. The Chandeysson Electric Co. had 80 reservations, and other firms had large groups.

Our loyal friend, E. Lamoureux, was present. Ernie has never failed us. He was responsible for the organization of St. Louis Branch at a time when it was said that there were not enough real platers in the whole West," to start a branch. Thank you, Ernie for your interest in us and you're quite a dancer I see.

There was just one thing that we all missed this time. We did not have a poem. Our poet, Past Editor Hedley Richards was present, but evidently had his mind on less important matters. Possibly he missed the inspiration of Ed Heil, who failed to arrive.

We regretted the inability of Past President Walter Fraine to come, due to a sad trip east.

H. H. Williams.

(The writer of this article or report is a past national president and editor De Luxe of the A. E. S., again displays his proportional modesty by omitting to mention the prominent part he always takes in the success of this annual event and the great interest he takes in this society. In addition to having a large attendance Mr. Chandeysson is also some dancer.—Editor.)

Regular meeting of the St. Louis Branch, A. E. S., was held at Central Y. M. C. A. on Friday, March 8, 1929.

After a very good dinner, meeting was called to order by chairman,

Mr. Al. Rufling. Minutes of previous meeting were read and approved. There were two letters read from our good friend, Frank Rushton of California, who told us of trying to start a branch of the A. E. S. in his part of the country.

Our banquet chairmen were given a rising vote of thanks for the way they handled the affair, which was a success, and were appointed chairmen for our next banquet. Everyone expressed themselves as having had a very enjoyable time.

Meeting was turned over to the librarian, who started discussion. Dr. Stout joined in and many questions were asked and discussed and some very good points were brought out which was of a benefit to all.

Meeting adjourned at 9:45 p. m. with 14 members present to meet again on the second Friday of April.

C. T. McGinley, Secy.

## DETROIT BRANCH

Detroit Branch held its regular monthly meeting at the Statler Hotel Friday evening, March 1, at 8 p. m., President E. V. Allen presiding. Minutes of the previous meeting approved as read. This meeting being one of the round-the-table sessions in which the old timers had the opportunity of talking over some of plating methods used in days gone by.

A. E. S. members will find time well spent by attending our national convention in July. Detroit has many surprises for plater that only the Dynamic city can offer.

Chas. M. Phillips, Secy.-Treas.

## CHICAGO BRANCH

Regular monthly meeting Chicago Branch held March 9 at Atlantic Hotel.

Meeting called to ordered, President Robt. Meyers presiding.

The meeting was well attended and it gave the officers inspiration to see so many members attend.

There being two elected to membership and one application received and the regular order of business being completed, the librarian conducted the meeting regarding the questions found in the question box.

Ques. 1. Would like some information on a cutting oil to take the place of paraffin oil for brass something that would be easier to clean.

Ans. 1. Left open for suggestion other branches please help.

Ques. 2. What speed should a 200-amp. carbon brush generator run? It has no plate showing speed.

Ans. 2. Suggested to get in touch with manufacturer of machine to get information.

Ques. 3. Is there a formula for oxidizing alumium black the ox to be such that it will not rub off, a dip formula is preferred?

Ans. 3. Suggest to plate black nickel.

Ques. 4. Will chromium plate cover nickel pitting and can you get a smooth surface on pitted nickel?

Ans. 4. No. Chrome magnifies these defects.

Ques. 5. What effects has the copper and brass which dissolves in a chrome solution on the working of the solution?

Ans. 5. It was thought that it will decrease the throwing power.

Ques. 6. In nickel plating red brass of composition 85 and 3 fives what is the maximum voltage at which a hot nickel with moving cathode can be run to get good soft nickel?

Ans. 6. Suggested about 3 volts be used.

Ques. 7. Can alumium be nickel plated so as to stand a bending of 45 per cent without peeling?

Ans. 7. No answer given calling for help from other branches.

There being no further business and general discussion being concluded, the meeting adjourned at 10:35 p. m.

S. J. C. Trapp, Secy.

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## MILWAUKEE BRANCH

Milwaukee Branch Annual Meet April 6, 1929, to be held at Schroder Hotel, Milwaukee, Wis.

### Educational Program

I. Paper by Nickolas De Cesare— Kohler Mfg. Co., Kohler, Wis. Chromium Plating—"A New Lease of Life for the Plater.

II. E. C. Bucy—Modern Lacquers. Waukegan Chemical Co., Waukegan, Ill.

III. Chas. H. Proctor and R. & H. Chemical Co., founder of American Electro-Platers' Society. "Is Iron a Detriment or Benefical Factor in Chromium Plating Solution."

IV. R. F. McGuire, United Chromium, Inc. Troubles of a Chromium Plater.

V. R. J. Hazucha, Maas & Walstein Co. Overcoming Spotting Out on Plated Articles.

The educational program will start promptly at 2 p. m. and banquet at 7 p. m. and it is hoped that every plater and factory representative in vicinity will attend this important meeting. The Hotel Schroder is easily accessible to the North Shore Electric and R. R., and a good time is in store for all.

Dan Wittig.

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## TORONTO BRANCH

The Toronto Branch held its usual monthly meeting on February 25 at 22 College St.

President J. Walker presiding. The attendance was better than usual. Discussions dealing with the general welfare of the branch took place, making the evening enjoyable.

Our meeting in March will be devoted entirely to President Smith's plan regarding nickel solutions. The members will have samples of their solutions with them in order to test and determine p.H. of same. This will be an opportunity to gather valuable data respecting standardizing methods and plating solutions.

W. J. Sutherland, Secy.-Treas.

# A. E. S. PAGE

## Assembled Expert Scraps With and Without Significance

*IRONICS*

*Frank Irving Fletcher*

One of the most important and most neglected lessons in salesmanship is to know when you are through without waiting for a reminder from the man you are talking to.

Never permit anybody but a check boy to hand you your hat and coat.

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*Reliable Confidant*

———"Can you keep a secret?"

"I am as silent as a tomb."

"I need to borrow some money."

"Don't worry. It is as though I never heard it."

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———Ole, the night porter, was testifying before the jury after the big bank robbery.

"You say," thundered the attorney, "that at midnight you were cleaning out the office, and eight masked men brushed past you and went on into the vault room with revolvers drawn?"

"Yah," said Ole.

"And a moment later a terrific explosion blew the vault door off and the same men went out past you carrying currency and bonds?"

"Yah," said Ole.

"Well, what did you do then?"

"Aye put down my mop."

"Yes, but then what did you do?"

"Vell, aye say to myself, 'Dis bane hell of a way to run a bank'."

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*Got a Kick Out of His Job*

———"What became of that hired man you got from the city?"

"Aw, he used to be a chauffeur, and one day he crawled under a mule to see why it wouldn't go."

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*Consideration*

———Foreman (to applicant): "Yes, I'll give ye a job sweeping and keeping the place clean."

Applicant: "But I'm a college graduate."

Foreman: "Well, then, maybe ye better start on something simpler."

## NEWARK BRANCH

Our February 15 meeting had an attendance of 25. President George Wagner presided. Minutes approved as read. Mr. John Merigold, a former Newarker now in Los Angeles, Cal., was reinstated to active membership.

Mr. Louis V. Taylor, who has been seriously ill, is convalescing and we sincerely trust he will soon meet with us again.

In the absence of our librarian, Mr. Geo. B. Hogaboom, conducted the educational session.

Questions were read from the MarchApril-May, 1912 Quarterly Review of our society, when it was the National Electro-Platers' Association of U. S. and Canada 17 years ago, and Mr. Hogaboom was its editor.

These questions related to the operating of a nickel solution, and were answered by the members to Mr. Hogaboom, who in turn spoke on the present day methods of operation. Those members who were not present missed a meeting which was exceedingly interesting to those who operate nickel solutions.

A rising vote of thanks was given Mr. Hogaboom for his talk.

Newark Branch held its regular meeting on Friday, March 1, with George J. Wagner as president and 20 members present.

Our charter will be dropped for 30 days due to the death of Howard W. Young, who died in January.

Banquet Committee reported progress and urged all members to be present at our April 5 meeting as it will be an open one with refreshments. A speaker will be secured. The Research Committee of the U. S. Bureau of Standards will be present at this meeting.

Our librarian, Mr. Philip Sievering, resigned due to increased duties in business and other channels, which Newark Branch very much regrets. A motion carried provides that the president appoint; for the balance of the fiscal year; a member to act as librarian for that particular meeting only.

This will give members a chance to act in this capacity to become familiar with the duties.

Mr. Lewis H. O'Donnell will fulfill this duty at our February 15 meeting and Mr. O. J. Sizelove at our April 5 meeting.

Discussion on methods used in removing an excess of free cyanide by boiling or adding bi-sulphite of soda, also how to compute the area in square inches upon an irregular shaped, object was taken up from the question box.

Adjourned at 10 p. m.

Royal F. Clark, Secy.-Treas.

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## BALTIMORE-WASHINGTON BRANCH

The above branch held its regular meeting at the Enoch Pratt Library, Calhoun and Hollins Streets, Baltimore, Md. President F. F. Pierdon presiding.

Our speaker of the evening our vice-president, Mr. M. J. Kraft, and

his subject was "Cleaning and Preparing Metals for Plating." He explained to us his methods which certainly was a surprise to many of us as his cleaner practically eliminates any other methods of preparing his work for plating. Stating his work was taken from the cleaning tank rinsed in water and then taken straight to the plating tank. His talk was very interesting and several question were asked. Fourteen members attend this meeting.

Seven new members were elected.

Question: Do you ever use pumice after your work is taken from cleaner? Answer: Very seldom.

Question: Do you use an electric cleaner? Answer: No.

Geo. P. Turner, Secy.-Treas.

## HARTFORD-CONNECTICUT VALLEY BRANCH

Hartford-Connecticut Valley Branch, A. E. S., held its February meeting at the Junior Achievement League Building at 33 Pearl St., Springfield, Mass., on Monday evening, February 25.

The meeting was called to order at 8:30 p. m. with President Elwin in the chair. Minutes of the previous meeting were read and accepted. All bills to date were ordered paid. Two applicants were elected active members to our branch. Two committees were appointed by the president. One committee consisting of the following members, to take charge of our banquet and educational session to be held on May 11; the members appointed were President Elwin, V. Grant, W. MacDermid, H. MacFayden and W. F. Kennedy. The other committee was to take care of the nomination of officers, for next term, these were, as follows: W. L. Kennedy, Geo. Vibberts and F. J. Clark.

There being no speaker for the evening, Past President Kennedy read a paper on "Chromium Plating," written by Oliver Sizelove. The paper was very interesting and created a discussion which lasted over an hour.

The meeting was attended by eighteen members and visitors. The meeting was adjourned at 10:30 p. m.

V. E. Grant, Secy.

## ROCHESTER BRANCH

The seventeenth annual banquet of the Rochester Branch will be held at the Power's Hotel, Rochester, N. Y., Saturday, April 13, 1929. Educational session at 3 p. m. and banquet at 6:30 p. m. Entertainment and dancing.

Rochester Branch held a very interesting meeting on January 15 at Power's Hotel with President Reama in the chair, it is very gratifying to our president to see the members attend meeting as they have in the past six months. The attendance and interest shown is remarkable.

Mr. Frank Mesick of the Metal Arts Co. was elected an active member.

After the regular meeting President Reama appointed Mr. Harry

W. Puffes and Mr. Clarence Fields to take charge of the nickel solution's tests. All members present were very much interested in the tests made and the discussion which followed.

The banquet committee reported that everything was progressing satisfactory for a successful banquet.

Mr. Eli Beandry reported that Barry's Melody Boys' Orchestra would furnish the music for the dinner and dancings.

It was reported that Mr. Frank Kolb and Mr. George B. Hogaboom would be the speaker at the educational session to be held in the afternoon.

Rochester Branch again invites you to be with us on April 13 at Power's Hotel.

Chas. Griffin, Secy.

## WORCESTER BRANCH

A joint meeting of the Worcester Branch of the American Electro-Platers' Society with the Worcester Section of the American Society for Steel Treating was held Thursday evening, March 7, at Rebboli's Restaurant. About forty men enjoyed a steak dinner, after which, Mr. George B. Hogaboom of the Hanson, Van Winkle, Munning Company gave an instructive talk on "Crystal Structure of Electro-deposited Metals," showing by many lantern slides how the nature of the deposit is affected by the crystal structure of the base metal, and making a plea for more cooperation between the metallurgist and the plater to obtain best results. Mr. Hogaboom also showed the effect of heat treatment and working on cast metal for anodes. Considerable discussion followed the talk.

R. H. Bryant, Secy.

## PITTSBURGH BRANCH

### Report of Meeting Held Friday Evening, March 1, 1929

Meeting opened at 8:30 p. m. with President Peter in chair, and after regular business had been disposed of, and Mr. L. M. Hague, Pittsburgh, Pa., was elected to an associate membership, the question of our April 5 meeting came up for discussion, as we will have as our speaker, Dr. William Blum, Bureau of Standards, Washington, D. C. Upon motion, it was decided to hold a dinner in the William Penn Hotel, and a committee of two, Mr. John E. Lohstoeter, and S. E. Hedden was appointed by the chair to make the necessary arrangements. From the discussion that followed, we have every hope of this being one of the outstanding events of the Pittsburgh Branch. Our speaker of the evening was Prof. Goodale, professor of Metallurgy, University of Pittsburgh, who spoke upon the subject of Relation of problems in the field of metallurgy to the plating industry. Prof. Goodale covered his subject in an able manner, giving the platers present a different view of just what happens in the electro-deposition of the various metals. His address was followed by a discussion in which every one present took part. Prof. Goodale was extended a

vote of thanks for his address, and responded by stating that he hoped to be back again with something just as interesting.

It is hoped that all members will remember the date and what is to take place next meeting, and that every member will cooperate with the committee in making this the meeting of the year.

S. E. Hedden, Secy.-Treas.

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## WATERBURY BRANCH

The annual "Get Together" meeting of Waterbury Branch was largely attended by members, friends and others interested in the speaker and his subject for discussion. Many of the local concerns had their plating experts and others interested in the art, present to obtain such information as might be of value and benefit to them. The speaker for the evening was Walter W. Rowe of Meriden and his subject "Chromium Plating." The able manner in which the speaker handled his subject, and the interesting exhibit of his handiwork which was on display, proved to all present, that Mr. Rowe was no novice at the chromium game. Starting in 1922 to master the intricacies of chromium plating, the speaker stated that he soon found out, that all was not to be a bed of roses. However, success eventually crowned his efforts, and today, chromium production comes almost as easy as the other lines of plating. Mr. Rowe attributes most of his success to the proper cleaning and nickel plating—especially in his own particular line of work. Bright and gay deposits were touched on and the manner of remedying the latter was discussed. After the talk a general discussion took place after which refreshments were served.

Wm. F. Guilfoile, Secy.

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## REINSTATEMENTS

| | Branch |
|---|---|
| John Merigold, 425 East 92nd St., Los Angeles, Cal. | Newark |

## RESIGNATIONS

| | Branch |
|---|---|
| Chas. H. Pease | Rochester |
| Wm. McDonald | Providence-Attleboro |
| Wm. Emard | Chicago |
| George Burt | Chicago |

## TRANSFERS

| | Branch |
|---|---|
| Jos. Ellis | From Toronto to (Temporary) Los Angeles |

## DEATHS

| | Branch |
|---|---|
| H. W. Young | Newark |

## SUSPENSIONS

| | Branch |
|---|---|
| Wm. Brown | Providence-Attleboro |

## SUSPENSIONS—(Continued)

| | Branch |
|---|---|
| Fred Carlon | Providence-Attleboro |
| Albert Ciske, 647 Aldine St., Chicago | Chicago |
| Joseph Cosgrove, 1513 17th Ave., Columbus, Ind | Chicago |
| G. W. Fox, 413 Milwaukee Ave., Chicago | Chicago |
| J. E. Fox, 413 Milwaukee Ave., Chicago | Chicago |
| Andrew Grasser, 910 N. Wood St., Chicago | Chicago |
| E. Hilliard, 2044 Bradley Place, Chicago | Chicago |
| V. Huebner, 540 Douglas Ave., Aurora, Ill | Chicago |
| G. Hurtig, 3833 Ward St., Chicago | Chicago |
| A. M. Kappeler, 708 Main St., Peoria, Ill | Chicago |
| Carl Moyer, 5406 Cullom Ave., Chicago, Ill | Chicago |
| C. A. Manz, 213 Marquette Rd., Chicago | Chicago |
| H. E. Stewart, 842 W. Erie St., Chicago | Chicago |
| F. Wrzalla, no address | Chicago |
| A. H. Wicks, 411 Vine St., Woodstock, Ill | Chicago |
| W. Donath, 605 Beloit Ave., Forest Park, Ill | Chicago |
| W. H. Hausen, 765 Cromwell Ave., St. Paul, Minn | Chicago |
| C. F. Posbeck, 3531 McLean Ave., Chicago, Ill | Chicago |

## APPLICATIONS

| | Branch |
|---|---|
| Lester N. Strunk, 32 Fairview St., Boyertown, Pa | Philadelphia |
| Martin H. Richter, Third and Pleasant St., Glenside, Pa | Philadelphia |
| Frederick R. Kilby, 649 Clifton St., Winnipeg, Minn., Can | Toronto |
| Frank Ruczka, 1642 S. 47th Court, Cicero, Ill | Chicago |
| Max Fisher, 3605 Bedford, Brooklyn, N. Y | New York |
| Vincent Tama, 121 Taaffee Place, Brooklyn, N. Y | New York |
| Nat. F. Nerderbaum, 835 Stebbins Ave., Bronx, N. Y | New York |

## ELECTIONS

| | |
|---|---|
| Theo. G. Hart, 1 Redwood St., Baltimore, Md | Baltimore-Washington |
| Aug. Borless, 316 N. Holiday St., Baltimore, Md | Balti.-Wash. |
| Richard Holmes, 805 E. Fayette St., Baltimore, Md | Balti.-Wash. |
| Irving Hahn, 207 S. Sharp St., Baltimore, Md | Baltimore-Washington |
| Robert Remmel, 1952 Pratt St., Baltimore, Md | Baltimore-Washington |
| Wm. Erimlich, 4 Broadship Rd., Dundalk, Baltimore Md | Balti-Wash. |
| Wm. Plitt, —— Kenlea Ave., Raspbury, Md | Baltimore-Washington |
| George A. Barker, c/o Eagle Lock Co., Terryville, Conn | Hartford-Connecticut Valley |
| Jos. Pietro, Jr., c/o Horton Mfg. Co., Bristol, Conn | Hartford-Connecticut Valley |
| F. J. Mesek, 639 Portland Ave., Rochester, N. Y | Rochester |
| Michael Gallo, 1008 Ave. O, Brooklyn, N. Y | New York |
| Harry Bernstein, 1601 West 7th St., Brooklyn, N. Y | New York |
| Peter Pitts, 3338 N. Oakley Blvd., Chicago, Ill | Chicago |
| Herbert G. Paplow, 339 Seldon St., Galesburg, Ill | Chicago |

**BALTIMORE-WASHINGTON**

Meets in Enoch Pratt Library, Calhoun and Hollins Sts. Geo. F. Turner, Secretary, Baltimore, Md.

**BOSTON**

Platers' Supply Co., 202 Friend St., Boston. Secretary, A. W. Garrett, 45 King St., Dorchester, Mass.

**BRIDGEPORT**

Meets first and third Friday of each month at 62 Cannon St., Room 17, Bridgeport, Conn. Secretary, Wm. Ehrencrona, 872 Hancock Ave., Bridgeport, Conn.

**CHICAGO**

Meets second Saturday of each month, at 8 p. m., Atlantic Hotel, 316 S. Clark St. Secretary, S. J. C. Trapp, 1127 N. 7th St., Maywood, Ill.

**CINCINNATI**

Meets every Thursday, 7:30 p. m., at Vocational Training School, Spring and Liberty St. Secretary, Al. Yeager, 2021 Sherman Ave., Norwood, Ohio.

**CLEVELAND**

Meets first Saturday of each month at Hotel Winton. H. Terdoest, 380 Pioneer Ave., Akron, Ohio.

**HARTFORD-CONN. VALLEY**

Meets fourth Monday in each month alternately at 266 Pearl St., Hartford, Conn., and corner Broadway and Worthington St., Springfield. Secretary, Vernon Grant, 43 Putnam St., Bristol, Conn.

**DAYTON**

Meets first Saturday of each month at the Y. M. C. A., Dayton, Ohio. Secretary, Robert G. Suman, 2734 Ridge Road, Dayton, Ohio.

**DETROIT**

Meets the first Friday of each month at the Hotel Statler, Louis II Room, Detroit. Secretary, Chas. Phillips, 13421 Camden Ave., Detroit, Mich.

**GRAND RAPIDS**

Meets on the second Saturday of each month at the Vocational High School, 129 Bostwick Ave., N. E. Secretary, Jacob Van Dyke, 1361 Union Ave., N. E., Grand Rapids, Mich.

**INDIANAPOLIS**

Meets the second Saturday of each month at Hotel Denison. Secretary, Louis Mertz, 1725 Union St., Indianapolis, Ind.

**MILWAUKEE**

Meets second and fourth Thursdays of each month at Cor. 3rd St. and Highland Ave. J. N. Hock, 1229 W. 24th St., Milwaukee, Wis.

**MONTREAL**

Meets last Friday of month at Office of Secretary, John H. Feelay, 411 Aylmer St., Quebec, Canada.

**NEWARK**

Meets first and third Fridays of each month at Franklin Hall, 41 Franklin St., Newark, N. J., at 8 p. m. Secretary-Treasurer, Royal F. Clark, P. O. Box 201, Newark, N. J.

**NEW YORK**

Meets every second and fourth Fridays of each month in the World Building, Park Row, New York City, N. Y. Secretary, R. J. Liquori, 2439 Hubbard St., Brooklyn, N. Y.

**PHILADELPHIA**

Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts. Secretary, P. Uhl, 2432 North 29th St., Philadelphia, Pa.

**PITTSBURGH**

Meets first Friday of each month at 8 p. m., at downtown branch, Y. M. C. A. Secretary, S. E. Hedden, 227 Fifth St., Aspinwall, Pa.

**PROVIDENCE-ATTLEBORO**

Meets first and third Thursday of each month at 44 Washington St., Prov. Engineers Rooms, Providence, R. I. Secretary, J. H. Andrews, 19 Rosedale St., Providence, R. I.

**ROCHESTER**

Meets every third Friday of each month at the Powers Hotel. Secretary, Chas. Griffin, 24 Garson Ave., Rochester, N. Y.

**ST. LOUIS**

Meets second Friday of each month at Central Y. M. C. A., 16th and Locust St. Secretary, C. T. McGinley, 8214 Fairham Ave., University City, Mo.

**TOLEDO**

Meets first Thursday of each month at Toledo Secor Hotel, corner Cherry and Page Sts. Secretary, W. W. Welker, 2228 Middlesex Rd., Route 2, Box 635, Toledo, Ohio.

**TORONTO**

Meets fourth Monday of each month at Canadian Foresters' Hall, 22 College St., Room No. 2. Secretary, W. J. Sutherland, 197 Gillard Ave., Toronto, 6, Canada.

**WATERBURY**

Meets every second and fourth Thursday of each month. Secretary, Wm. F. Guilfoile, Garden Theatre Bldg., East Main St., Waterbury, Conn.

**WORCESTER**

Meets Directors' Room, Chamber of Commerce, Worcester, Mass. Roger H. Bryant, Secretary.